REPORT OF THE NATIONAL SCIENCE FOUNDATION TASK FORCE ON PERSONS WITH DISABILITIES

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NATIONAL SCIENCE FOUNDATION

TASK FORCE ON PERSONS WITH DISABILITIES

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EXECUTIVE SUMMARY

An ongoing concern of the Task Force on Persons with Disabilities was the question "who are we talking about and how many persons with disabilities are there?" With other underrepresented groups such questions are easily answered and there are plenty of data; but this is not true for disabled individuals. One figure provides a context within which this final report should be read: of the approximately 5,000,000 scientists and engineers in the U.S., at least 100,000 have disabilities.

The Division of Science Resources Studies reviewed Federal data and the definitions of "disability" used in obtaining that data. Based thereon, SRS provided rough estimates of several populations relevant to the issue of moving more persons with disabilities into the pipeline and into careers in science, engineering, and science education. Those estimates are:

* U.S. Adult Population: 15 to 17 percent:
* Experienced Science and Engineering Population: 2 to 16 percent:
* College-aged Population: 4 to 11 percent; and
* Youth Population: 3 percent (0 - 17 years of age) to 9 percent (6 - 17 years of age)

Findings of the Task Force are consistent with statements made over the years by members of CEOSE, by staff at the AAAS Office of Education and Human Resources Programs, by the Interagency Task Force on Women, Minorities and the Handicapped in Science and Technology, and by other members of the community of persons with disabilities.

The most obvious finding is that persons with disabilities are subject to double jeopardy--they face negative attitudes not unlike those faced by minorities and women plus barriers of accessibility, of communication, and, for some, of dealing with extended time required to do things, from obtaining a Ph.D. to accomplishing the tasks of everyday living. Those persons with disabilities who are also women and/or minorities face even more obstacles to obtaining a quality education and pursuing a career in their chosen field of science, science education, or engineering.

The major pipeline issues that surfaced were:

* The negative attitudes about the ability of a student with a disability to do science, mathematics, engineering, or science education of parents and other gatekeepers (teachers, counselors, rehabilitation staff, special education teachers, health personnel, and academic faculty).

* The virtual invisibility of role models in science, science education, and engineering for children with disabilities; one witness before the Task Force said he had worked with deaf children who thought deaf people were short-lived because they had never met a deaf adult.

* Students and faculty with disabilities may appear less qualified than their non-disabled peers because they may have a shorter record of traditional educational and/or professional activities than people their same age. They may have taken longer to complete their pre-college education (due to such things as down time while under intense medical care, having to master languages others need not master, e.g., braille); they may not have received the same numbers of honors because of the negative stereotypes mentioned above (and for other reasons); and they may have devoted considerable time and energy developing skills to counteract the system's negative attitudes and to accommodate to inaccessible environments.

* Some persons with disabilities may believe they will not fare well in any sort of competition with their non-disabled counterparts (because they have internalized negative stereotypes or because they believe they will be viewed through negative stereotypes).

* Scientists, science educators, and engineers with disabilities must deal with the additional and ongoing costs associated with their disabilities: special telephones, door bells, and alarms for deaf people: manageable living quarters, cars, and other facets of everyday living for persons with mobility impairments; alternate (and more expensive) transportation, such as taxis because buses are not accessible; or personal assistants, readers, signers, note takers, or other human assistance, are all additional costs incurred by individuals with disabilities.

* Although there is much technology that can help people with disabilities to live, learn, and work independently, information about that technology is not widely available. In particular, there is very little awareness of the technology that exists to help teachers to teach science to students with disabilities.

A revitalized effort must be made by the Foundation on many fronts in bringing disabled persons into science, engineering, and science education careers. NSF must:

* make public its commitment to working in this area and use its considerable influence on the academic community to join NSF in its efforts to tap this reservoir of talent (for example, through the issuance of an Important Notice from the Director of the National Science Foundation to college presidents);

* establish specific new initiatives, centrally managed by knowledgeable staff, to provide opportunities to students and faculty with disabilities;

* modify existing NSF programs to provide expanded opportunities to students and faculty with disabilities;

* solicit much-needed research to identify ways to overcome some of the barriers, e.g., those of attitude;

* finally, put its own house in order in a number of areas, including increasing representation of persons with disabilities on its staff and advisory committees, holding barrier-free meetings, captioning (closed or open) of video materials that are produced with NSF funding, and in other ways.

INTRODUCTION AND BACKGROUND

Recognizing that persons with disabilities are probably seriously underrepresented in science, engineering, and science education careers, and therefore constitute an important resource for a nation facing a shortage of scientists and engineers, in early 1990 the Director of the National Science Foundation established the Task Force on Persons with Disabilities. He charged the Task Force with:

* examining existing data concerning persons with disabilities, and about scientists, engineers, and science educators,

* isolating factors contributing to the low numbers of persons with disabilities in those careers,

* reviewing Foundation activities and programs as they relate to persons with disabilities, and

* recommending, as appropriate, additions to and/or modifications of Foundation programs/policies that address these factors.

Who is Disabled? How Manv People with Disabilities are There in the NSF Community (pipeline and scientists and engineers)?

The first concern of the Task Force had to be "who are we talking about and how many persons with disabilities are there?" With other underrepresented groups such questions are easily answered and there are plenty of data; but this is not true for disabled individuals. At what point, for example, along the continuum of vision loss, is the line drawn where the loss constitutes a disability? Does the loss of two fingers constitute a disability--for many the answer would be "no" but for a concert pianist, it would be "yes." The experts in this field--US Census, the community of persons with disabilities, and others--have not agreed on one definition; there are as many definitions as there are surveys and data sets.

Even if we could agree upon a definition of "disability," there remains the problem of deciding who determines if a particular individual fits that definition. Reasonable people may disagree whether a given individual fits the definition, and the individual has his/her own answer to the question. Whose answer is the "right" answer?

The Task Force could have spent a considerable time on these issues alone but this did not seem appropriate, given the charge made to the Task Force. Assistance was sought from the Division of Science Resources Studies. Their review of Federal data found the following range in estimates for persons with disabilities in selected population segments:

* U.S. Adult Population (25 - 64 years old):

  15 to 17 percent

* College-aged Population (18 - 24 years old):

  4 to 11 percent

* Youth Population (0 - 17 years old):

  3 to 9 percent

* Experienced Science and Engineering Population:

  2 to 16 percent[1]

As the population becomes older, the percent of members of that population with a disability becomes higher.

What about Persons with Disabilities that are not Motor, Orthopedic, or Sensory?

Assuming resolutions of these technical problems, there remained some policy issues in the definition of the group. The most troublesome is whether the Foundation should concern itself only with persons with motor, orthopedic, and/or sensory disabilities or should also deal with issues relating to other disabilities as well, including, for example, persons with emotional problems, persons with learning disabilities, and persons with various developmental disabilities. The Task Force members were fully aware, for example, of a number of well-known scientists who have dyslexia or other learning disabilities whose work is recognized as creative and important.

There is no question whether persons with such other disabilities are encompassed within the Foundation's commitment to preventing discrimination based on disability in its own employment practices and in those of grant recipients (as required by Section 504 of the Rehabilitation Act). Nor is there any question that programs and activities of NSF must be accessible to persons with disabilities other than motor, orthopedic, or sensory disabilities. The question here is whether the Foundation should try to design programs that would effectively and

[1] These two percentages are derived from two surveys of the same population; however, the surveys used different questions in asking about disability. The difference in percentage is primarily due to the different questions asked, rather than a change in the disability status of the population. See Part II, pages 18 and 19.

predictably increase the number of persons with such disabilities in science and engineering careers. The Task Force, after considerable thought, decided that at this time the issues are perhaps too complex, too unclear, or that the payoff would be too small to warrant extensive efforts in these directions. Therefore, the Task Force recommends that the Foundation initially concentrate its efforts in the area of persons with motor, orthopedic, and/or sensory disabilities, while at the same time vigorously enforcing Section 504 in its own programs and activities.

What are the Similarities and Differences between Persons with Disabilities and other Groups Underrenresented in Science and Engineering?

Persons with disabilities are subject to double jeopardy--they face negative attitudes not unlike those faced by minorities and women plus barriers of accessibility, of communication, and, for some, of dealing with extended time required to do things, from obtaining a Ph.D. to accomplishing the tasks of everyday living.

The Interagency Task Force on Women, Minorities, and the Handicapped in Science and Technology found that negative attitudes are the single most significant barrier faced by students with disabilities at all levels of education and by others beyond their education in careers in science, engineering, and science education. Testimony before this Task Force has reinforced that finding over and over again. This is not very different from the major barrier for women and minorities. However, persons with disabilities have additional barriers to overcome: they may not be able to work at the laboratory bench; they may not be able to see the text; or they may not be able to hear the lecturer or the lab assistant.

Gatekeepers play a highly significant role in the lives of persons with disabilities, particularly those with an early age of onset of their disability. Gatekeepers are individuals in positions to either open up a whole range of opportunities for students or close off whole ranges of opportunity. For minorities and women pre-college gatekeepers are mostly counselors and teachers. Students with disabilities have additional gatekeepers--special education teachers and, most importantly, vocational rehabilitation counselors. The latter can authorize payment of a student's college expenses if he/she agrees that the student can and should pursue their career of choice. If the counselor does not think the student is capable ("science is too hard for someone like you"), he/she can discourage the student and/or refuse to provide funding for college education.

For all three groups--persons with disabilities, minorities, and women--parents also play a key role in their children's attitudes toward themselves and their own abilities. Parents, particularly of children with disabilities, may try to protect their children from failure and discourage them from taking on "hard" studies,

such as mathematics or science.

Finally, a significant difference between minorities and women on the one hand and persons with disabilities on the other is the dynamic nature of the population of persons with disabilities: as the chapter on data shows, the older the population, the higher the percentage of its members who have a disability. People enter (and in the case of temporary disabilities, leave) this population in a way that does not happen to the populations of minority groups and of women.

What Should the Foundation's Commitment Be to Address Issues Related to Disability?

A revitalized effort of significant proportions must be made by the Foundation on many fronts in bringing disabled persons into science, engineering, and science education careers. NSF must: make public its commitment to working in this area and use its considerable influence on the academic community to join NSF in its efforts to tap this reservoir of talent (for example, through the issuance of an Important Notice from the Director to college presidents): establish specific new initiatives, centrally managed by knowledgeable staff, to provide opportunities to students and faculty with disabilities; modify existing NSF programs to provide expanded opportunities to students and faculty with disabilities; solicit much-needed research to identify ways to overcome some of the barriers, e.g., those of attitude; finally, put its own house in order in a number of areas, including increasing representation of persons with disabilities on its staff and advisory committees, holding barrier-free meetings, captioning (closed or open) its video materials, and in other ways.

What should NSF do about Persons with Serious Disabilities who do not Self-identify as having a Disability?

As with other groups viewed as "different," some persons with disabilities lack confidence in the system and/or in themselves and will not apply for any program that fails to signal, in some way, that their applications will be welcome. Others, whom most would consider to be disabled, choose not to consider themselves so and would not apply for any program designed to help persons with disabilities. Clearly the second group neither requests nor accepts assistance of this nature and is not the primary concern of this Task Force.

* * * * * * *

The Task Force first examined current levels of support by the Foundation of activities relevant to the concerns of the Task Force. It found that during FY 1989, at least $7,000,000 was awarded to proposals in which PI's or at least one co-PI self-identified as having a disability. An additional $8,000,000 supported a variety of relevant educational activities and

topical research and funded various types of accommodations for scientists or engineers with disabilities to do research. This support is important and must be continued. In addition, however, it is the conviction of the Task Force members that other efforts must be put forth, new programs advanced, and many ongoing NSF programs enhanced if the Foundation is to influence the educational and scientific and engineering worlds to make some fundamental changes in the opportunities available to students, scientists, science educators, and engineers with disabilities.

The Task Force identified a number of areas in which it made findings and major recommendations. They are listed in succeeding sections of this report; within each section the recommendations are listed in order of significance of impact on barriers to persons with disabilities entering and advancing in science, science education, and engineering careers. In Appendix A are listed global concerns about disabled individuals and science, engineering, and science education which are beyond NSF's ability, by itself, to affect. In Appendix B are examples of activities that can impact on the problems addressed by this Task Force. In Appendix C are detailed charts, figures, and tables that support the narrative summarizing Federal data on persons with disabilities.

Hearing impaired individuals wishing more information about the Task Force should call: TDD (202) 357-9867

PART I

FINDINGS AND RECOMMENDATIONS

PART I

FINDINGS AND RECOMMENDATIONS

A. OPERATIONAL CHANGES WITHIN THE FOUNDATION

1. AUTHORIZATION OF NSF TO DESIGN PROGRAMS SPECIFICALLY FOR PERSONS WITH DISABILITIES

FINDING

The National Science Foundation is becoming increasingly aware of the need to bring persons with disabilities to the forefront of the nation's efforts to expand its supply of scientists and engineers. Although it was clear at the time of the passage of the Science and Engineering Equal Opportunities Act, that persons with disabilities were included in the language of the act "other groups currently underrepresented in scientific, engineering, and professional fields," people with disabilities were not specifically named, as were women and minorities.

RECOMMENDATION

The Foundation should ask Congress to add persons with disabilities to minorities and women as another group that is underrepresented in the science and engineering professions whose increased participation in such careers shall be encouraged by Foundation programs and activities.

2. CREATION OF AN OFFICE/PROGRAM WITH PRIMARY RESPONSIBILITY FOR MATTERS DEALING WITH DISABILITIES ISSUES

FINDING

The National Science Foundation will place increasing emphasis on disability issues in the years to come. Until now, the efforts that have been made at NSF have been dispersed among individual program officers in the various directorates with a special knowledge of and/or interest in the issue. Beyond those individuals, there are very few staff who are sufficiently knowledgeable about the population and the issues to design appropriate programs or initiatives.

RECOMMENDATION

An office/program should be established that would:

* provide central management of programs for persons with disabilities described in this report until such time as those programs can be mainstreamed into "regular" NSF programs:

* serve as a source of assistance and oversight/guidance to others in the Foundation involved in disability issues, particularly in the areas of the technologies available to help persons with disabilities and of the most effective methods of outreach to, and recruitment of, persons with disabilities: and

* through its very existence help to serve notice on the scientific, science education, and engineering communities that the Foundation takes very seriously its role in this area.

3. MODIFICATIONS OF CERTAIN NSF INTERNAL OPERATIONS

ORIENT NSF STAFF TO THE SPECIAL NEEDS OF PERSONS WITH DISABILITIES

FINDING

Program officers at the Foundation have been inundated over the past several years with changing requirements for targeted programs: initially, for some programs they were asked to review proposals, fund awards made, but not make the funding decision itself. In others, although the program officers made the award decisions, they had to spend a given amount of money for those programs for women or for minorities. At a time when the Foundation is receiving far more very good proposals to do research than it can fund, there is a natural tendency to want to use the targeted funds for the underfunded "regular" research programs.

Now program officers may be faced with more targeted programs and/or set asides having to do with a whole "new" category of persons, those with disabilities.

RECOMMENDATIONS

To ensure a high level of understanding on the part of NSF program staff concerning the population of persons with disabilities, of the reasons that the population requires special targeting, and of the kinds of strategies that can and should be used to assist them in entering and advancing in careers in science, science education, and engineering, NSF should:

* Distribute the final report of the Task Force to all NSF program staff. Ensure discussion of the report and of its possible impact on each program in each division.

* Incorporate training by knowledgeable individuals about Federal and NSF responsibilities concerning persons with disabilities into the program managers' training program and other appropriate training situations.

CENTRALIZING FACILITATION AWARDS FOR THE HANDICAPPED (FAH)

FINDING

It is not possible to predict where, when, or for how much FAH requests will be made: virtually all Foundation programs are eligible and costs vary a great deal, depending upon the nature of the individual accommodation required. Therefore, the costs cannot be budgeted and must come out of the program officer's program funds. An unknown number of accommodations have not been funded for lack of funds within the individual programs.

RECOMMENDATION

A specific amount of money should be available at a central location within NSF to reimburse program officers who have used program funds to provide an accommodation needed by a funded student or faculty member with a disability. The accommodation might be extra travel funds, money to pay an interpreter, money to buy an assistive device, or other reasonable accommodation necessary to the performance of the individual with a disability under an NSF grant.

(To reflect the terminology preferred by the disabled community, the program should be renamed "Disability Accommodation Award" or some similar name that does not refer to "the handicapped." However, since the reader knows the meaning of "FAH," that acronym will be used throughout this report.)

INCREASE REPRESENTATION OF PERSONS WITH DISABILITIES AMONG STAFF, ADVISORY COMMITTEE MEMBERS, AND AD HOC REVIEWERS

FINDING

One of the stated reasons for having outside expert members on this Task Force, even though there were none in its two predecessor task forces on minorities and women, was that so few NSF staff understood the problems facing persons with disabilities in

science, science education, and engineering. If NSF is to become more pro-active-in this area, it will have to raise the level of such understanding of its staff, of the various advisory committees, and of its ad hoc reviewers.

RECOMMENDATION

The Foundation must raise its level of sensitivity to and awareness of disability issues through more effective recruitment of persons with disabilities in all phases of Foundation activities.

REVISION OF NSF FORMS 1225 AND 98A

FINDING

As has been discussed in several sections of this report, data on persons with disabilities are few and those that there are use a variety of definitions of **"disability."** Questions concerning disability status on NSF forms 1225 and 98A appropriately use the definition of **"disability"** used in the Rehabilitation Act and in the Americans with Disabilities Act. However, as Foundation programs/initiatives/services for persons with disabilities increase, more information about type of disability will be required, since accommodations vary a great deal, depending on the nature of the disability.

RECOMMENDATION

The Foundation ought to revise its forms to add the following to its question about disability: the form should collect information about whether the disability relates to hearing impairment, visual impairment, mobility/-orthopedic impairment, or other. The Task Force also recommends that this change be made as soon as possible, before other Federal agencies adopt **NSF's** forms.

OTHER NSF CHANGES

FINDING

From time to time, NSF has either held, or funded, conferences and meetings that were not accessible to persons with disabilities. Some of NSF's products (e.g., videos, announcements) and some products funded by NSF are not accessible to persons with a visual or hearing impairment. People in the various disability communities have been ill informed about NSF activities of interest to them, at least in part because the appropriate media have not been informed of those activities. Staff have not been able to provide helpful information to **PI's**

and others who ask about the technology that is available to assist persons with disabilities.

RECOMMENDATION

NSF should ensure that:

* All meetings, conferences, and other NSF gatherings are accessible to the disabled community in every sense of the word.

* All meetings, conferences, and other gatherings funded in part or fully by NSF are accessible.

* All NSF-funded videos, films, TV shows, and other visual media are captioned (closed or open) for the hearing impaired.

* NSF press releases are available to media sources which target disabled populations.

* NSF staff receives training in the availability of technology to assist persons with disabilities to gain access to science, science education, and engineering activities in a wide variety of ways.

* Serious consideration is given to the question of whether or not certain basic Foundation documents (e.g., Grants for Research and Education in Science and Engineering, Guide to Programs, program announcements) should be produced in alternate formats (primarily tapes) or be available in such formats upon request.

B. NEW PROGRAMS

RESEARCH OPPORTUNITIES FOR STUDENTS WITH DISABILITIES

FINDING

Students with disabilities studying science, science education, or engineering are perceived as less qualified to be research assistants than others:

Negative stereotypes about abilities of persons with disabilities will adversely affect assessments of such students.

Undergraduate and graduate students with disabilities may have accumulated less time employed in relevant work: at times when students without disabilities work (e.g., summers and during the school year) some students with disabilities cannot assume they will be available to work (surgery or other medical treatment may be required, getting through the day's activities may take longer, and other difficulties).

Even if a student with a disability appears to be highly qualified, the research laboratory may not be accessible or it may not be reached by accessible public transportation. Such difficulties may discourage even the most motivated faculty member from selecting such a student to serve as a research assistant.

Finally, there is the possibility that the researcher has an uneasy feeling, a level of discomfort, in dealing with a disabled student. This intangible factor can be what tips the scale in favor of another but non-disabled candidate.

RECOMMENDATION

A centralized account should be created to provide funds to recruit and support pre-college, undergraduate, and graduate students with disabilities to work on individual research funded by NSF. FAH funds should be available to provide accommodations--for example, travel supplements, interpreters, or assistive devices--needed by the student to perform his/her research and related activities.

NSF centers are unique resources, because of their connection with private industry, to provide disabled individuals work and study opportunities in science and engineering, particularly at the pre-college and undergraduate levels. Students with disabilities are likely to have less work experience than others and need exposure to the opportunities in private industry. For such students, a successful work history can be of even greater importance by providing evidence to counter negative attitudes.

NSF should initiate NSF research apprenticeships for students with disabilities at NSF centers. The centers would provide disabled students--at the pre-college and undergraduate levels--opportunities to work, study, and do research at the centers. To ensure the inclusion of minority students with disabilities in this program, the six Minority Research Centers of Excellence should be assisted in recruiting and hiring minority students with disabilities.

NSF would provide funds to cover salaries and reasonable expenses of the students with disabilities.

NSF should obtain the services of disability experts who could help the centers identify and recruit candidates with disabilities.

RESEARCH INITIATION FOR FACULTY WITH DISABILITIES

FINDING

Faculty with disabilities may appear less qualified than their non-disabled peers because they may have a shorter record of traditional educational and/or professional activities than people their same age. Publications may be fewer and employment histories shorter because it can take a longer time to obtain degrees, to do research and write up and publish results, and to accomplish all the other steps along the way to becoming an upward-moving faculty member. Honors and awards may be fewer because of the above factors plus the negative attitudes about the abilities of persons with disabilities that are mentioned throughout this report.

RECOMMENDATION

A research initiation program, similar in all essential respects to the Research Initiation Awards programs in the Engineering and Computer and Information Science and Engineering Directorates, should be established. As part of this program, funds must be available to pay for extra costs incurred which are disability-related and are required for the faculty member to conduct the research and perform related functions.

VISITING PROFESSORSHIPS FOR FACULTY WITH DISABILITIES

FINDING

For the same reasons that scientists, science educators, and engineers with disabilities can benefit from research initiation awards early in their careers, experienced scientists, science educators, and engineers can benefit from opportunities to undertake advanced research and teaching as a visiting professor at another institution. In addition, the Task Force received recommendations from several of its witnesses that NSF devise ways to make scientists, science educators, and engineers with disabilities visible to students at all levels and to faculty: to be role models for the students and object-lessons for faculty who have their doubts about whether one who has a disability can be a scientist, science educator, or engineer.

RECOMMENDATION

NSF should establish a program of visiting professorships for faculty with disabilities similar in all essential respects to Visiting Professorships for Women with research and outreach components. As part of this program, funds must be available to pay for extra costs incurred which are disability-related and are required for the faculty member to move to the host institution, conduct research there, perform outreach activities, and accomplish all related functions.

NATIONAL AWARDS FOR OUTSTANDING SCIENTISTS, ENGINEERS, AND SCIENCE EDUCATORS WITH DISABILITIES

FINDING

Students with disabilities who are trying to envision themselves as adults working in an exciting career need to know that there are many talented and contributing scientists, engineers, and science educators who have disabilities.

One of the most poignant statements to this effect was made by the last witness to appear before the Task Force who said that he has known a number of young children with disabilities who believe that they will die before they become an adult because they have never seen a disabled adult.

Additionally, gatekeepers at the pre-college level, parents, college faculty and employers also need to know that having a disability does not prevent one from being a successful scientist, engineer or science educator.

RECOMMENDATIONS

NSF post-doctoral awards should be made annually to recognize outstanding young researchers with disabilities in any field of science, engineering, or science education supported by the NSF. These awards would provide funds for up to three years of post-doctoral studies at an institution of the awardee's choice. Candidates would be nominated by universities, colleges, or professional societies. A committee of distinguished scientists, engineers, science educators, and mathematicians, including representatives of the disabled community, would review the nominations.

An NSF award should also be created to recognize one or more senior scientists, science educators, and/or engineers

with disabilities who have made major contributions to science, engineering, or science education. Candidates would be nominated by universities, colleges, or professional societies. A committee of distinguished scientists, engineers, science educators, and mathematicians, including representatives of the disabled community, would review the nominations.

One of the conditions of these awards is that recipients would allow videotapes or other media presentations to be made about their careers in science, science education, or engineering that can be shown to a wide variety of audiences, including representatives of the media, that will benefit from seeing a distinguished scientist, science educator, or engineer who incidentally has a disability.

C. NEW INITIATIVES

GRADUATE FELLOWSHIPS FOR STUDENTS WITH DISABILITIES

FINDING

Some graduate students with disabilities, faced all their lives with negative attitudes from the various school, rehabilitative, and other systems of which they have been a part, may well believe that there is no point in applying for the prestigious NSF graduate fellowships. They may downplay their own abilities or believe that the NSF **"system"** will not take their applications seriously (since they believe they may not be viewed as competitive with their peers).

RECOMMENDATION

The Graduate Fellowships Program should have a special subsection for students with disabilities but which is in all other essential respects similar to the basic program. As part of this program, funds must be available to pay for extra costs incurred which are disability-related and are required for the awardee to study, conduct research, and engage in related activities.

SOLICITATIONS FOR PROPOSALS IN ATTITUDE AND OPPORTUNITY ISSUES

FINDING

As has been stated in other parts of this report, attitudes held by others that individuals with disabilities cannot do science or engineering are the primary barriers facing students with disabilities preparing for and entering into careers in science, science education, and engineering. Many parents, medical professionals, teachers, vocational rehabilitation, faculty (particularly some born and raised in other countries) and other counselors may discourage, forbid, or in any of a variety of other ways exclude students with disabilities from the challenges of science and mathematics in pre-college education. Though the barriers are easily identified, they are not easily removed.

RECOMMENDATION

The Education and Human Resources directorate (EHR) should issue one or more solicitations calling for proposals in the following subject areas:

* develop and test strategies and/or materials designed to change stereotypical views held by "gatekeepers" about (1) the capability of students with disabilities to do science and engineering and (2) educational and career options in science:

* create opportunities for disabled and non-disabled students to be exposed to and work with disabled role models in science, science education, and engineering through such things as media portrayal of scientists and engineers with disabilities and visits to schools of scientists, engineers, and science educators with disabilities:

* initiate studies of the successful paths through the pipeline taken by established scientists, engineers, and science educators with disabilities;

* initiate studies of the reasons why students with disabilities who had an early interest and talent in science gave up on studying science, analyzed by age of onset and type of disability:

* study the unique problems faced by minority and female students with disabilities;

* develop strategies for assisting teachers, parents, and allied health professionals to help disabled students with goal-setting and exploration of educational and

career options, particularly through the expanded use of technology;

* develop materials for high school disciplinary teachers, parents, special education teachers, and counselors to assist them in guiding disabled high school students as they plan for college;

* develop strategies and materials that will expand opportunities for K-16 students with disabilities to participate in such informal educational experiences as those provided by science centers, aquariums, and museums;

* convene conferences of vocational rehabilitation, high school, and undergraduate academic counselors to learn about science and engineering career options for disabled students and requisite educational paths;

* initiate a study, or project, to determine effective ways of reaching and assisting undergraduate science, science education, and engineering instructors to integrate students with disabilities into undergraduate science and engineering courses and programs;

* prepare materials for college and university disabled student counselors to assist them in advising disabled students about course background requirements, general requirements of programs in science, science education, and engineering, alternate science and engineering programs, laboratory adaptations and accommodations, disabled science and engineering role models, and career opportunities for scientists, science educators, and engineers with disabilities:

* initiate a study of the loss of vital talent in science, science education, and engineering due to lack of reasonable accommodations or failure to provide re-training opportunities by employers of scientists, science educators, and engineers following a change in physical or sensory status; and

* develop and make available information and materials for pre-graduate and graduate students, and their mentors, to help facilitate the removal of the barriers and problems faced by disabled students in graduate education;

SOLICITATIONS FOR PROPOSALS IN CURRICULUM DEVELOPMENT AND TEACHER TRAINING ACTIVITIES

FINDING

The general lack of knowledge, experience, and training in the area of teaching science to disabled youth by special education, elementary, elementary science, middle school science, and high school science teachers is a widespread problem. Likewise, knowledge and experience about teaching science and engineering to disabled students in higher education is virtually non-existent. The restructuring of science and engineering teaching must be coupled with the increased access of disabled students to such changes through adaptive technologies, materials, and texts. The "teach-to-the-text" classical methods of teaching science (as against the hands-on, experiment-driven approach) are deeply embedded in our schools, and although research shows that they are not the best methods to teach science to youth, they are the most frequently used. This strong coupling of the K-12 science curriculum to the science textbook strongly suggests that initial strategies for disabled students be developed with the cooperation of textbook publishers.

RECOMMENDATIONS FOR CURRICULUM DEVELOPMENT

The EHR directorate should issue one or more solicitations calling for proposals to:

* Develop hands-on instructional materials for teaching K-12 science to students with disabilities.

* Assess existing K-12 science teaching materials designed for students with disabilities and identify specific areas of the science curriculum and types of disabilities that lack appropriate materials.

* Develop K - 12 science materials--including text books and assistive materials such as overheads, instructors manuals, study guides, and test banks--which integrate disabled student needs and special concerns (e.g., incorporating disabled scientist and engineer role models into textbooks).

* Because hands-on science is the best method of teaching science to students with disabilities, examine the elementary and middle school science curricula of those countries using such methods and showing superior student performance in science and mathematics standardized tests (such as Japan, Hong Kong, etc.); adapt same for use in US schools.

* Examine paths by which instructional materials and technological aids developed for teaching science to students with disabilities are disseminated and identify which paths are most effective.

* Develop, in cooperation with college textbook and laboratory manual publishers, texts and adjunct teaching materials to assist disabled science, science education, and engineering students.

RECOMMENDATIONS FOR TEACHER TRAINING ACTIVITIES

The EHR directorate should issue one or more solicitations calling for proposals to:

* Develop pre-service materials and methods for training classroom science teachers, special education teachers, and teachers in schools for the deaf and blind how to teach science to students with disabilities through the use of appropriate strategies, particularly through the expanded use of technology. These materials should include state-of-the-art technology, e.g., computer-controlled inter-active presentations (video and/or experimental).

* Incorporate into pre-service science education curricula (science methods courses) significant activities on mitigative strategies (also including the use of role models) and technologies, in the education of disabled students K-12.

* Initiate in-service programs to instruct K-12 teachers of disabled students in the existence of and use of curriculum technologies, and strategies, for teaching **"hands-on"** science to students with disabilities.

NSF PROGRAMS FOR MINORITIES - OUTREACH TO MINORITIES WITH DISABILITIES

FINDING

Minority men and women who have disabilities suffer two- and three-fold discrimination in their educational and career opportunities, in addition to having to deal with barriers of communication, physical access, and--for many--the increased costs in time and money of accomplishing goals.

RECOMMENDATION

NSF should ensure that all programs for underrepresented minorities receive assistance, at least initially from the

office/program described in A.2. above, in recruiting or reaching out to minorities with disabilities to participate in these programs.

Programs that reach out to pre-college students in particular should receive priority attention. For example, Comprehensive Regional Centers for Minorities, located in institutions with significant minority enrollments, serve students in local school systems and people in local community organizations working with minorities, as well as serve the students in the institutions themselves. Such centers are ideal organizations to reach out to minority students with disabilities to ensure that they are included in all programs offered by the center. Another pre-college program is Research Assistantships for Minority High School Students. Model projects of Career Access serve undergraduates.

Other programs that should ensure recruitment of minorities with disabilities include: Alliances for Minority Participation, Minority Graduate Fellowships, Research Careers for Minority Scholars, Minority Research Initiation, and Minority Research Centers of Excellence.

While neither the Young Scholars program nor the Research Experience for Undergraduates program is a minority-targeted program, each should, insofar as it recruits minorities, recruit minorities with disabilities.

NSF PROGRAMS FOR WOMEN - OUTREACH TO WOMEN WITH DISABILITIES

FINDING

Women who have disabilities suffer at least double discrimination in their educational and career opportunities, in addition to having to deal with barriers of communication, physical access, and--for many--the increased costs in time and money of accomplishing goals due to their disabilities.

RECOMMENDATION

NSF should ensure that all programs targeted toward women receive assistance, at least initially from the office/-program described in A.2. above, in encouraging women with disabilities to participate in these programs. Programs that should encourage women with disabilities to participate include: Visiting Professorships for Women, Faculty Awards for Women, Research Planning Grants, and Career Advancement Awards.

CLEARINGHOUSE FOR INFORMATION AND MATERIALS CONCERNING DISABLED PERSONS AND SCIENCE, SCIENCE EDUCATION, AND ENGINEERING

FINDING

Disabled youth, people who work with disabled youth, and people who work with youth, any one of whom could become disabled at any time, lack access to information about educational tracks, mitigative strategies, appropriate technologies, and career opportunities in science and engineering. Disabled individuals and their gatekeepers need to have a centralized point of access to this information.

RECOMMENDATIONS

NSF should fund the development of a clearinghouse for science and engineering educational materials relating to disabled students: general information in the teaching and learning of science for students with disabilities; scientists, engineers, and science educators with disabilities who can serve as role models; and research findings on the science and engineering education of disabled students at all levels. This might be done on a contract basis through an R.F.P.

NSF should initiate broad-based national efforts to locate materials and other information for teaching science and engineering to students with disabilities, evaluate and abstract the materials, and disseminate them through the clearinghouse.

NSF should develop and disseminate information (workshops, newsletters, computer disks, videos, electronic bulletin boards, etc.) about appropriate communication modes for disabled students to facilitate access to science and engineering information.

NSF should ensure that the bibliographies, abstracts, and all other outputs of such a clearinghouse are available in appropriate modes of communication for all types of disabled people: e.g., audio tapes, braille, hard copy, computer disks, and electronic networks.

The clearinghouse should include support for the following on-line facilities on the NSFnet or other appropriate network:

* a database containing the Handbook on 508 Compliance (requirements of federal agencies that they make office equipment accessible) currently published by the GSA Clearinghouse for Computer Accommodation;

* an on-line directory of currently available computer access technology and products;

* an on-line directory of scientists, science educators, and engineers with disabilities: and

* an on-line, constantly updated database of challenging open problems related to computers and persons with disabilities.

PART II

DATA ON PERSONS WITH DISABILITIES

A. A Summary of Federal Data on Persons with Disabilities

Although the discussion below will make it only too clear that data on persons with disabilities are not as available as data for other groups underrepresented in science and engineering, one number should be kept in mind throughout the discussion below. According to surveys of various groups which together comprise the general science and engineering population of the US totaling 5,000,000, a minimum of 2% of that population, or 100,000+ scientists and engineers have disabilities.

A review of Federal data on different segments of the populations listed, using differing definitions of "disability," found the following range in percentages for persons with disabilities:

* U.S. Adult Population: 15 to 17 percent:
* Experienced Science and Engineering Population: 2 to 16 percent;[1]
* College-aged Population: 4 to 11 percent; and
* Youth Population: 3 percent (O-17 years of age) to 9 percent (6-17 years of age).

Data sources reviewed for this section provide several alternative definitions of "disability." None of these is entirely satisfactory for measuring the degree of disability among the population of current and potential scientists and engineers. Yet taken together, the different definitions, and the populations among which they were estimated, provide a means of identifying a set of estimates for different segments of the population.

The estimates presented herein do not result from the calculation of confidence margins using classical statistical techniques. Rather they result from critical assessment of individual data series, and from comparison across these series.

1. Estimates of the Disabled Population

Estimates have been compiled for four segments of the population: (a) the adult population, approximately 25 to 64 years of age, (b) the science and engineering population, ages 25 to 64 years,

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[1]This is a subset of the 5,000,000 total science and engineering population mentioned above; this experienced subset numbers 1,700,000.

(c) the college-aged population, 16 to 24, and (d) the youth population, under 18 years of age.

U.S. Adult Population

The National Health Interview Survey (NHIS) for 1985 shows 15 percent of the adult population (17 million persons) reported "a limitation in major activity" (see Appendix C, table I-A).[1] In contrast, an upper bound may be derived from the 1984 Survey of Income and Program Participation (SIPP). In this survey, approximately 17 percent, or 20 million persons, reported a functional limitation (see Appendix C, table I-G).

Other findings:

* The presence of a limitation does not equate with the presence of a work disability. For example, roughly 54 percent who reported any functional limitation on SIPP reported that they did not have a work disability (see Appendix C, table I-F).

  In the same survey, 17 percent with a severe functional limitation reported no work disability.

* Limitation in work activities as a result of chronic conditions declines as education level increases (see Appendix C, figure 1). In the NHIS, about one-fifth of persons who had eight years or less of schooling were "unable to work" (see Appendix C, table I-E). This percentage declined to 3 percent for persons with 13 to 15 years of education and to less than 2 percent for those who had finished college.[2]

* The presence of functional limitations and work disabilities increases with age, with the most significant increases occurring after age 54 (see Appendix C, figures 2 and 3).

Science and Engineering (S&E) Population

Estimates in the number of experienced scientists and engineers[3] with disabilities range from roughly 2 percent (38,000) to 16 percent (288,000) (see Appendix C, tables IV-E, third section, and IV-A). The lower estimate was derived from the 1986 National Survey of Natural and Social Scientists and Engineers in which survey participants were asked if they had a physical disability and if so, to identify the nature of that disability (e.g., visual, ambulatory, or auditory). The upper estimate is from the

same survey conducted in 1989. In the latter survey, respondents were queried on a series of questions about the degree of difficulty they had with seeing, hearing, and walking and to what extent those functional limitations affected their education, employment, and career.

Other findings:

* The proportion of the experienced S&E population reporting a functional limitation increases with age (figure 4). While roughly 9 percent of persons under age 40 reported a limitation, almost 17 percent of those between 40 and 49, and 21 percent of persons between 50 and 64 did so (see Appendix C, table IV-B).

* Among experienced scientists and engineers with functional limitations, small fractions report that their limitations have affected their education, employment, and career advancement (figure 5). Between 2 and 3 percent indicated some problem in completing school or finding employment and more than 6 percent reported some problem in career advancement (see Appendix C, table IV-C).

* In addition to experienced scientists and engineers, some information is available on the total U.S. population of scientists and engineers, i.e., experienced persons as well as those who have entered the S&E work force since 1980. In 1986, roughly 100,000, or 2 percent, of all scientists and engineers reported a physical impairment (see Appendix C, table IV-E). This fraction varies by age. Whereas, about one percent of scientists and engineers under age 50 report a physical impairment, more than four percent of those over 50 did so.

College-Aged Population

Among the college-aged population, a lower bound estimate of the number of persons with disabilities is approximately 4 to 6 percent. The 1988 Current Population Survey (CPS) gives an estimate of roughly 3.8 percent (1.3 million) of the population between 16 and 24 having either a severe or non-severe work disability (see Appendix C, table I-C). The 1985 NHIS shows that roughly 6 percent of individuals (1.6 million) between 18 and 24 years of age had a limitation in major activity (see Appendix C, table I-A).

The Fall 1986 National Postsecondary Student Aid Survey may be used to provide an upper estimate. About 11 percent, or 1.3 million, postsecondary students (15 years of age or older) in

either undergraduate, graduate, or first-professional degree programs had a disability (see Appendix C, table III-B).

Other findings:

* Major fields of study do not differ substantially between disabled and non-disabled students at the undergraduate level (see Appendix C, table III-A). However, at the graduate and first-professional level, some differences emerge. For example, roughly one-half of disabled students compared to less than two-fifths of non-disabled students were studying law.

* A higher fraction of disabled than non-disabled students are over age thirty: 33 percent and 24 percent, respectively. Higher proportions of disabled students are also male and veterans (see Appendix C, table III-C).

Youth Population

The 1985 NHIS shows approximately 3.6 percent (2.3 million) of persons under age 17 have a limitation in major activities whereas 1984 SIPP reported 3.1 percent (1.9 million) of this population had either a physical, mental, or emotional disability (see Appendix C, tables II-A and C). In contrast, information on program participation from the Office of Special Education Programs (Department of Education) estimates that the 3.9 million persons enrolled in programs represent about 9 percent of children between 6 and 17 years of age in 1988 (see Appendix C, table II-D).

2. Selected Definitions of Disability

The following discussion of data sources highlights issues involving differences in both definitions of disabilities and in data collection methodologies of which the reader should be aware. For a full discussion of both definitions and methodology, the reader is referred to the original source documents listed in part 3.

Limitation of Activity

The NHIS uses the concept "limitation of activity" to refer to long-term reductions in activities resulting from chronic

conditions. The concept is normally broken down into persons with:

-limitation in their non-major activity:
-limitation in the amount or kind of their usual activity;
-inability to carry on their usual activity.

For children, the **major activity is** playing or attending school. For adults the major activity may be working, keeping house, living independently, etc.

A **chronic condition** is a condition appearing at least 3. months before the date of interview, or a condition considered chronic whenever it began.

Functional Limitation

Two surveys discussed in this report use the concept "functional **limitation":** the Survey of Income and Program Participation (SIPP) and the National Survey of Natural and Social Scientists and Engineers. Persons with **"disabilities"** in these surveys are persons with limitations in their ability to perform specific functional activities defined, variously, as seeing, hearing, speaking, lifting or carrying, etc.

Usually the functional limitation is divided into two measures of degree: some **limitation,** and **great limitation/or unable.**

Work Disabilitv

Work disabilities is used in two of the surveys reviewed in this report (see Appendix C, chart I). In SIPP, a work disability question was asked only of adults aged 16 to 72 and concerned only the ability to work at a job or business. In SIPP, which also uses functional limitation, the two concepts, **"work** disability" and "functional limitation," are not precisely the same measure (see Appendix C, table I-F).

In the Current Population Survey (CPS), work disability is defined by a set of criteria. A person is considered to have a work disability if one of the following conditions is met:

If persons state that they have a condition preventing or limiting their work

If a person retired or left a job for health reasons

If the person did not work in the survey week due to a long term condition

If the person did not work at all in the previous year because of illness

If the person is under 65 and receives Medicare

If the person is under 65 and receives Supplemental Security Income

In CPS, if any one of the final four criteria is met, the work disability is considered severe.

Program Participation

Data from the Office of Special Education Programs of the Department of Education was used in this report to provide an upper estimate of disability among the school-aged population. These data are collected from state reporting agencies and include students enrolled in a variety of special education programs under various Federal statutes.

The reader is cautioned that these program participation data are not subject to statistical tests. The source document also shows large differences in state-level percentages on the various measures which strongly suggest wide variation in state reporting practices as well as possible wide variation in state program participation rates.

Physical Impairment

Authors of this report used "self-identified physical impairment" in cases where survey respondents self-reported physical impairments, i.e., all but one of the NSF surveys and the NCES survey of postsecondary education.

In the NSF surveys, respondents were given the choice of identifying "visual," "auditory," "ambulatory," etc., impairments.

NCES also gave respondents great leeway in identifying their own physical impairments and may have especially overestimated the amount of "visual" impairment.

3. Sources

Bureau of the Census. Disability, Functional Limitation, and Health Insurance Coverase: 1984/85. Washington, D.C.: Bureau of the Census, 1986.

Bennefield, Robert L. and John M. McNeil. Labor Force Status and Other Characteristics of Persons With a Work Disability: 1981 to 1988. Washington, D.C.: Bureau of the Census, 1989.

Collins, John Gary. Health Characteristics bv Occupation and Industry: United States, 1983-85. Hyattsville, Md.: National Center for Health Statistics, 1989.

Greene, Bernard and Linda Zimbler. Profile of Handicapped Students in Postsecondarv Education, 1987. Washington, D.C.: National Center for Education Statistics, 1989.

LaPlante, Mitchell P. Data on Disability from the National Health Interview Survey, 1983-1985. Washington, D.C.: National Institute on Disability and Rehabilitation Research, 1988.

National Center for Health Statistics. Current Estimates From the National Health Interview Survey, 1988. Hyattsville, Md.: National Center for Health Statistics, 1989.

National Science Foundation, Division of Science Resources Studies. 1989 National Survey of Natural and Social Scientists and Ensineers, unpublished tabulations.

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National Science Foundation, Division of Science Resources Studies. 1987 Survey of Doctorate Recipients, unpublished tabulations.

National Science Foundation, Division of Science Resources Studies. U.S. Scientists and Engineers: 1986, unpublished tabulations.

Office of Special Education and Rehabilitative Services. Eleventh Annual Report to Congress on the Implementation of The Education of the Handicapped Act. Washington, D.C.: U.S. Department of Education, 1989.

ENDNOTES

[1]See part B for a discussion of definitions used in the surveys.

[2]Authors of this section did not explore other socioeconomic variables which are strongly related to disability status. However, the Bureau of the Census notes:

> The data do not allow for a determination of causality and it seems very likely that both directions are important. That is, disability has a causal effect on schooling, schooling has a causal effect on disability. From a more basic point of view, it may be that high rates of disability and low levels of schooling are both caused by economic and social disadvantages experienced in childhood.

See Bureau of the Census, p. 5.

[3]Experienced scientists and engineers are defined as those persons who reported a science or engineering occupation on the 1980 Decennial Census.

[4]Disabilities include physical impairments related to sight, hearing, and mobility as well as learning disabilities. It should be noted that question wording was such that survey analysts warn that students reporting visual disabilities may include such conditions as myopia.

B. Data on Persons with Disabilities and Foundation Programs and Activities

To establish a benchmark of the rate of participation of persons with disabilities in Foundation programs and activities, data are provided below in the following areas:

1. FY 1989 NSF Support of PI's with Disabilities:
2. FY 1989 NSF Support of PYI's, Graduate Fellows, and Minority Graduate Fellows with Disabilities:
3. Disability Status of Members of the National Science Board, NSF Staff, and Committees as of 1989 and 1990; and
4. FY 1989 NSF Educational, Facilitation, and Topical Research Project Support

1. FY 89 NSF Support of Principal Investisators with Disabilities

NSF asks proposers to indicate whether they have a disability. Submission of the information is voluntary, so those who do not wish to identify themselves cannot be included in calculations concerning funding or success rates for proposers with disabilities.

In FY 1989, $7.1 million was awarded to proposals in which PI's or at least one co-PI indicated that he or she had a disability. Of that, $2.5 million was awarded to proposals in which at least one co-PI self-identified as having a disability, and $4.6 million was awarded to PI's. Among PI's, those submitting proposals to disciplinary research directorates received $3.9 million.

Across the five disciplinary research directorates, the success rate for proposals upon which a competitive decision was made in FY 1989 was 31%. For proposals submitted to these directorates by PI's who identified themselves as having a disability, the success rate was 35%. Across all seven directorates, proposals submitted by disabled PI's who identified themselves had a 31% chance of success.

2. FY 1989 NSF Support of PYI's, Graduate Fellows, and Minority Graduate Fellows with Disabilities

Of the 197 Presidential Young Investigator awards made in FY 1989, one of the $25,000 awards went to a person with a disability. Of the 1657 eligible nominees, 7 had disabilities.

The following tables show the distribution of individuals who identified themselves as having a disability among FY 1989 graduate fellowship applicants, awardees, and honorable mention recipients.

fellowship applicants, awardees, and honorable mention recipients.

1989 NSF GRADUATE FELLOWSHIP PROGRAM

DISABILITY STATUS OF AWARDEES, HONORABLE MENTIONS,

AND ALL APPLICANTS

	WITH A DISABILITY	NO DISABILITY	STATUS UNKNOWN	TOTAL ALL
Awardee	8	746	6	760
Honorable Mention	18	1594	7	1619
All Applicants	73	5263	31	5367

1989 NSF MINORITY GRADUATE FELLOWSHIP PROGRAM

DISABILITY STATUS OF AWARDEES, HONORABLE MENTIONS,

AND ALL APPLICANTS

	WITH A DISABILITY	NO DISABILITY	STATUS UNKNOWN	TOTAL ALL
Awardee	1	98	1	100
Honorable Mention	2	247	2	251
All Applicants	13	777	7	797

3. DISABILITY STATUS OF NSB AND NSF STAFF AND COMMITTEES AS OF 1989 AND 1990

	TOTAL	NO. & PERCENT WITH A DISABILITY		NO. & PERCENT WITH A SEVERE DISABILITY	
NATIONAL SCIENCE BOARD	15	0	0.0%	0	0.0%
NSF ADVISORY COMMITTEES	1,046	8	0.8%	(not available)	
NSF STAFF					
SES	95	0	0.0	0	0.0%
Scientists/Engineers (excl.SES)	438	28	6.4%	1	0.2%
Other	770	31	4.0%	7	0.9%
STAFF TOTAL	1,303	59	4.5%	8	0.6%

4. NSF Educational, Facilitation, and Topical Research Project Support

During FY 1989, over $8 million was spent by NSF in direct support of activities involving or benefiting persons with disabilities. This figure and its components are probably minimums, not maximums:

* A minimum of $4 million was spent on applied research on technology for persons with disabilities.

* At least $3 million was awarded for basic research with direct implications for aiding persons with disabilities in the future.

* More than $850,000 was awarded in support of science and engineering education involving students with disabilities or teachers of students with disabilities.

* Students, technicians, and researchers on NSF grants received at least $200,000 to provide assistive devices or services that allow them to participate in the awards.

APPENDICES

APPENDIX A - Issues Beyond NSF's Reach Concerning Persons with Disabilities and Science, Engineering, and Science Education

There are a number of major issues in the area of disability and science, engineering, and science education that the Task Force discussed but had to exclude from its final report because of their global nature. These are issues that NSF could not have sufficient impact upon or that NSF would not have a sufficiently direct interest to justify expending scarce resources thereon. Nevertheless, these issues should be surfaced.

1. Disabilitv Data:

As federal, state, and local government agency officials begin enforcing the Americans with Disabilities Act (ADA), it will become all too apparent that there are no consistent data available about Americans with disabilities and no accepted definition(s) of key concepts, including that of "disability." Data must be collected about persons with disabilities' participation in the educational systems (including degrees earned data), in employment, and in a wide variety of similar areas. Only after these problems have been addressed will the magnitude of the difficulties that have been the subject of this Task Force and of the problems that led to the enactment of the ADA become known with any precision.

2. Academia and Compliance with Section 504 of the 1973 Rehabilitation Act:

Section 504 of the Rehabilitation Act of 1973 requires recipients of federal funds to make their programs, activities, and services accessible to persons with disabilities. This includes familiar requirements to make buildings and laboratories physically accessible, but it also means making lectures accessible to deaf students, providing readers or technological equivalents to blind students, and other reasonable accommodations for students with disabilities. Program accessibility must be emphasized.

The Department of Education, which has compliance oversight in this area, is not able to expend the kind of resources that would be necessary to do appropriate compliance reviews of all institutions of elementary, secondary, and post-secondary education under Section 504. NSF also has an obligation to ensure compliance with Section 504 by all recipients of NSF funds; it, too, lacks the resources necessary to ensure such compliance.

It was not surprising to the Task Force, in this context of inadequate resources for oversight, to learn that compliance is spotty. In listening to witnesses, reviewing prior recommendations to the Foundation, and otherwise trying to learn what is actually happening on campuses vis-a-vis students with disabi-

lities and science, science education, and engineering courses, it was all too apparent that some campuses are doing an outstanding job but most are not. New horror stories of faculty excluding students with disabilities from their science courses continue to surface.

The Foundation cannot, and should not, try to do on its own what so many other federal agencies are also required to do--ensure compliance with Section 504. Nevertheless, under ADA or Section 504, greater oversight of compliance with the law is necessary before several of the major barriers to students with disabilities entering majors, and eventually careers, in science, science education, and engineering can be overcome: negative attitudes of teachers and faculty; and accessibility of education services to all.

3. Academic Strategy of Cultivating Students vs. Weeding Them Out:

Students with disabilities who have been faced with negative stereotypes by personnel of educational institutions throughout their elementary and secondary education will have internalized those attitudes to some extent, unless they are extremely self-confident individuals. So long as academia views its primary pedagogical role to be to weed out those who cannot make it in a narrowly defined, highly competitive classroom situation (sometimes called the "Teach the best, shoot the rest" theory of education), students with disabilities will be disproportionately affected. Science, science education, and engineering will lose potential practitioners because the classroom has been viewed as a playing field rather than a classroom: and for students with disabilities, the playing field is not level.

Clearly, bringing about a revolution in academia is beyond the scope or objectives of the Foundation. Nevertheless, the issue is highly significant to the national effort to "grow" more scientists, science educators, and engineers.

4. Reward Systems in Academia:

The reward systems of many colleges and universities do not assign value to faculty efforts to increase the opportunities of students with disabilities to excel in their chosen disciplines. There is a great deal of work to be done by faculty if students with disabilities (and women and minority students, as well) are to receive an education equal to that afforded by these institutions to non-disabled majority male students. The reward systems, many of which give primary recognition to the traditional accomplishments of accumulating research grant monies and publishing research, must change if faculty are to do creative work in the areas of teaching, understanding and removing obstacles to achievement, and the many other activities described throughout this report.

5. Scientists, Engineers, and Science Educators with New or Changing Disabilities:

When a fully-trained and productive scientist, engineer, or science educator becomes disabled or when such a person's disability changes in a way that imposes significantly greater limitations on work activities, the total loss of his/her participation in the work force is likely, though frequently not necessary. For example, a considerable number of academic scientists and engineers with disabilities retire on disability at around the age of fifty, because the disability makes them less mobile, for example, in a field requiring considerable mobility. With some minor re-training, such an individual could re-direct his/her research into a related area where less mobility is required. An investment in retraining might help someone remain productive for another 20 years or more. The same dynamics hold for a newly-disabled scientist, engineer, or science educator. Employers cannot afford to give up such talent and must devise means to avoid such unnecessary losses.

6. Hands-on Science in Pre-college Education:

Most science taught in elementary and secondary schools, if any, is text-driven; that is, science stays in a book and rarely becomes an experiment in the laboratory or the classroom. Teachers, who frequently are mathematics and science shy, prefer the more controllable text approach over experiments because the students might ask questions in the experiment context that the teachers cannot answer. Yet research shows that students are "turned on" to science by experimenting: students with disabilities in particular benefit from this approach.

Until there are extensive materials, including good teachers guides, available to teachers for use in experimental science education, some of which deal with teaching hands-on science to students with various types and degrees of disabilities, far fewer disabled students will eventually select science, science education, or engineering careers.

7. The Media:

Most persons with disabilities object to their near invisibility in the media and to their portrayal in negative stereotypes on the few occasions that they do appear in movies, television shows, newspapers, and other areas of the media. Until this erroneous stereotyping is changed, the negative attitudes toward persons with disabilities will remain entrenched and will continue to be a primary barrier to participating fully in society.

APPENDIX B - Examples of Activities that Can Impact on the Problems Addressed by the Task Force

Greater visibility of scientists, science educators, and engineers with disabilities is critical to the success of many of the recommendations in this report. Such role models could be enlisted to make presentations at workshops about issues of disability and science, science education, and engineering. Such workshops could be part of regional and national discipline focused functions (e.g., The American Chemical Society, the American Statistical Association).

The major discipline associations in science and engineering should initiate or revitalize committees on disability to gather and disseminate information about disability in their discipline (especially career-related information).

Develop, with the Vocational Rehabilitation Administration, science career and role model materials for special educators, science teachers, parents and counsellors to give to and discuss with disabled high school students preparing to make the transition from high school to college.

Multi-media information needs to be developed concerning the science experience in college for disabled students.

Develop and disseminate strategies to get more disabled science, science education, and engineering individuals funded by State, Federal, and non-profit organizations through information and assistance in: matching skills and expertise to the appropriate funding area: educating disabled science, science education, and engineering individuals about grant preparation; and supplying assistance in the writing and editing of initial grant proposals.

Bring disabled scientists together (nationally or perhaps by region) to engage in a variety of activities, e.g., discussion: joint proposal preparation: workshops on proposal writing; strategies for career advancement; counseling by successful disabled scientists, science educators, and engineers about career advancement in academia, government, and industry. This could also be a series of summer conferences for disabled scientists to attend with two-fold purposes: 1) to interact with other disabled scientists in an open format on any scientific, science education, or engineering topic for brainstorming and 2) to have the groups sub-divide into specific assigned topics and write position papers dealing with e.g.: science, science education, and engineering and disabled students (K-16), pre-service teachers of disabled students, in-service teachers of disabled students, graduate/post-doctoral disabled students, career advancement, and employed/unemployed/retired disabled scientists, science educators, and engineers.

Fund projects focused on changing the pre-service curriculum to improve the teaching of science, particularly to encourage the use of role models who can "prove" that persons with disabilities can do science, science education, and engineering. The revised curriculum should target K-12 teachers, elementary science teachers, elementary special education teachers, and science teachers.

Develop up-to-date materials for high school science teachers to help them inform their students about regional and national pre-college experimental science and engineering programs in which disabled students may participate. This is very much needed for the science teachers of disabled students in the mainstream, mainstream specialty programs, and in the schools for the deaf and the blind.

APPENDIX C - Statistical Support for Data on Persons with Disabilities

1. **CHARTS**

Chart I. Data Sources and Characteristics
Chart II. Data Sources by Population of Interest

Chart I: Data Sources and Characteristics

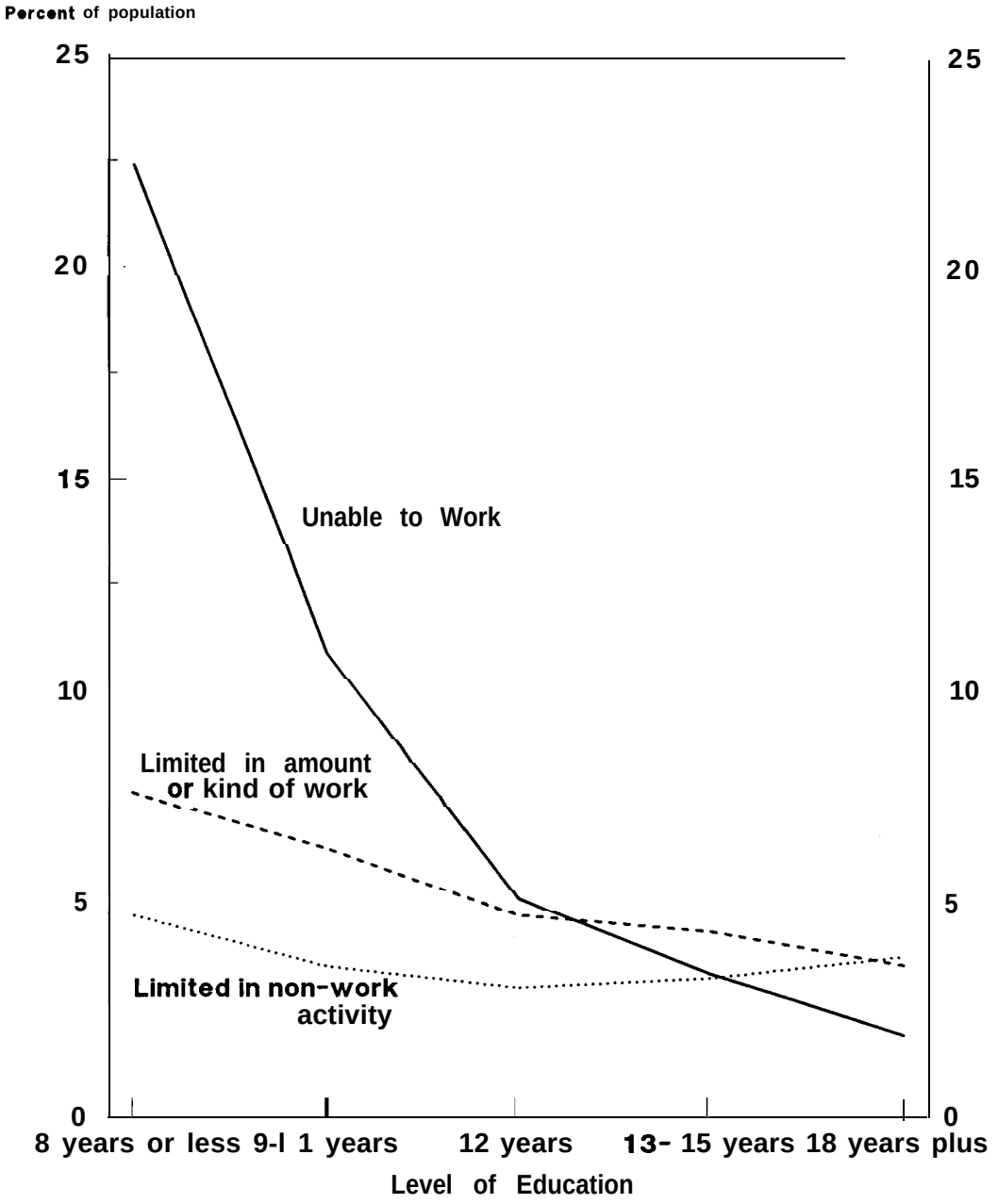
Data Source	years	Survey Type	Principal concepts				
			Activity Limitation	Functional limitation	Disabilities	Program Participation	Self-identified physical impairment
National Health Interview Survey	1988	households	XXXX				
	average of 1983-85	households	xxxx				
Survey of Income and Program Participation	1984	households		XXXX	XXXX		
Current Population Survey	1981-88	households			XXXX		
Office of Special Education Programs	school year 1987-88	not a survey				XXXX	
NCES Profile of Handicapped Students in Postsecondary E&cation	Fat l 1986	individual					XXXX
National Survey of Natural and Social Scientists and Engineers	1989	individual		XXXX			
Survey of Recent Science and Engineering Graduates	1988	individual					XXXX
Survey of Doctorate Recipients	1987	individual					XXXX
Survey of Earned Doctorates	1987-88 co&.	individual					XXXX
U.S. Scientists and Engineers	1986	not a survey					XXXX

Chart II. Data Sources by Population of Interest

Data Source	Population of Interest				Table reference
	Adult population	Youth population	Postsecondary population	Science and Engineering population	
National Health Interview Survey	XXXX	XXXX			I-A, B II-A, B
#2	xxxx				
Survey of Income and Program Participation	xxxx	xxxx			I-f,G II-C
Current Population Survey	xxxx				I-C,D
Office of Special Education Programs		XXXX			II-D
NCES Profile of Handicapped Students in Postsecondary Education			XXXX		III-A,B,C
National Survey of Natural and Social Scientists and Engineers				XXXX	IV-A,B,C,D
Survey of Recent Science and Engineering Graduates				XXXX	IV-F
Survey of Doctorate Recipients				XXXX	IV-E
Survey of Earned Doctorates				XXXX	IV-F
U.S. Scientists and Engineers				XXXX	IV-E

2. FIGURES

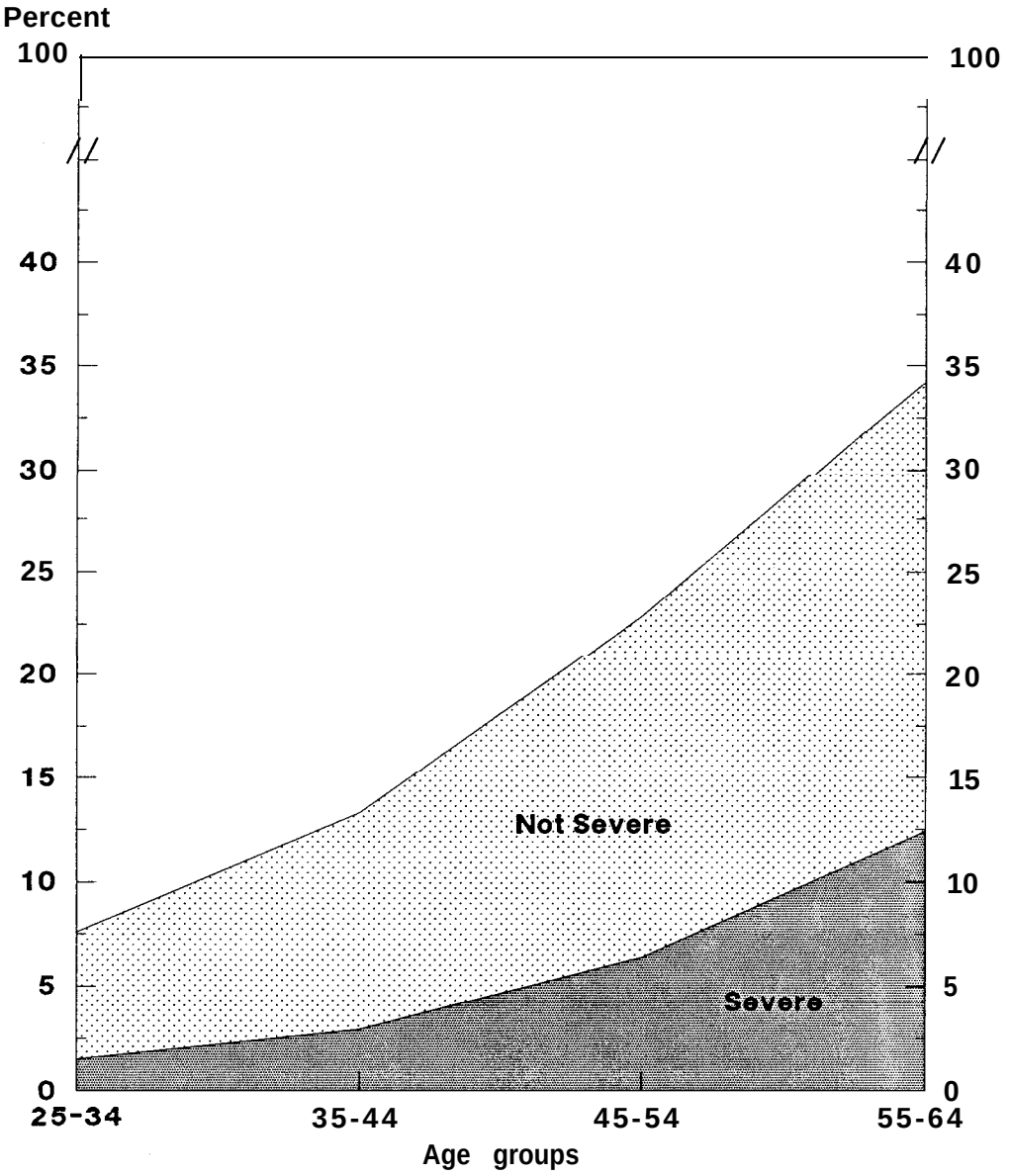
Figure 1.
Work Limitations by Years of Education: 1983-85



SOURCE: Mitchell LaPlante, "Data on Disability from the National Health Interview Survey, 1983-85," Prepared for the National Institute on Disability and Rehabilitation Research (1988).

See Table I-E.

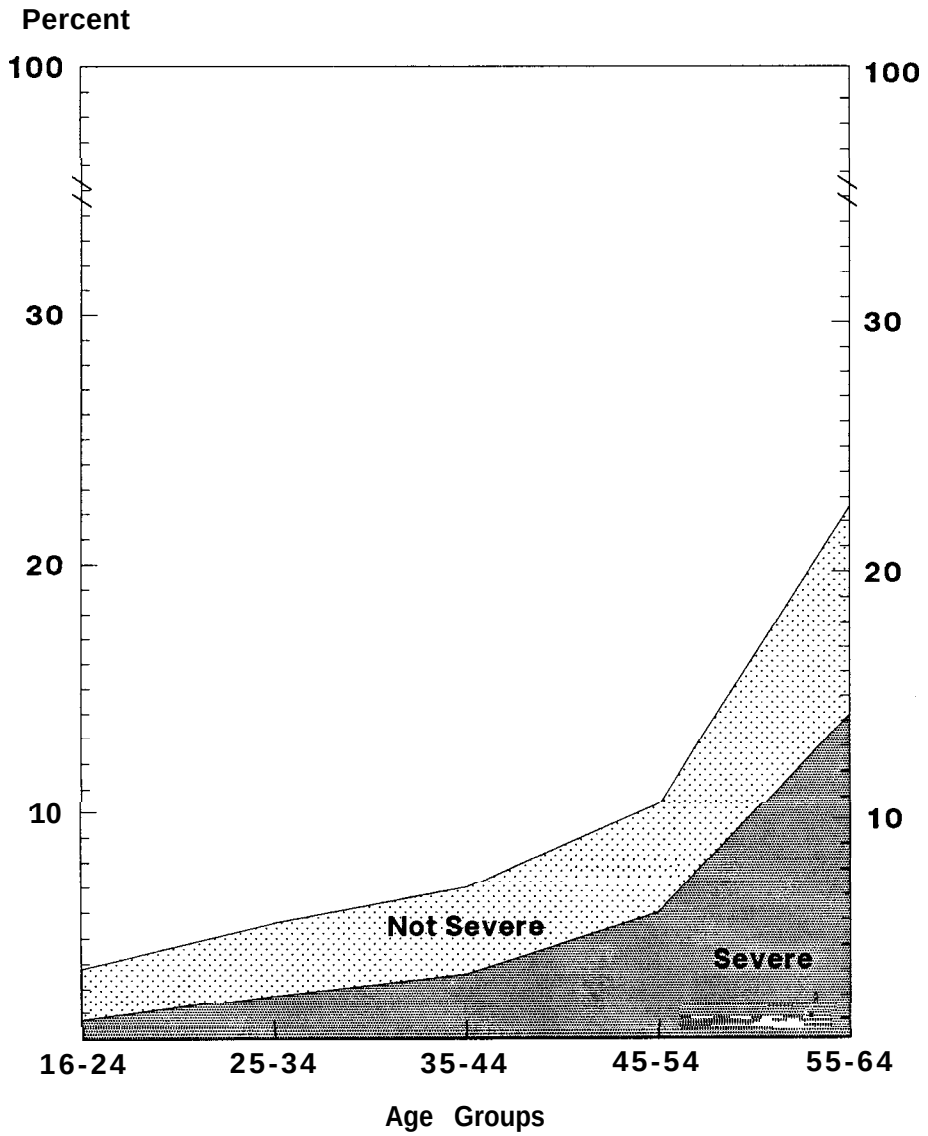
Figure 2.
Percent of Population with Functional Limitations, by Degree of Limitation



SOURCE: Bureau of the Census, Survey of Income and Program Participation

See Table I-G.

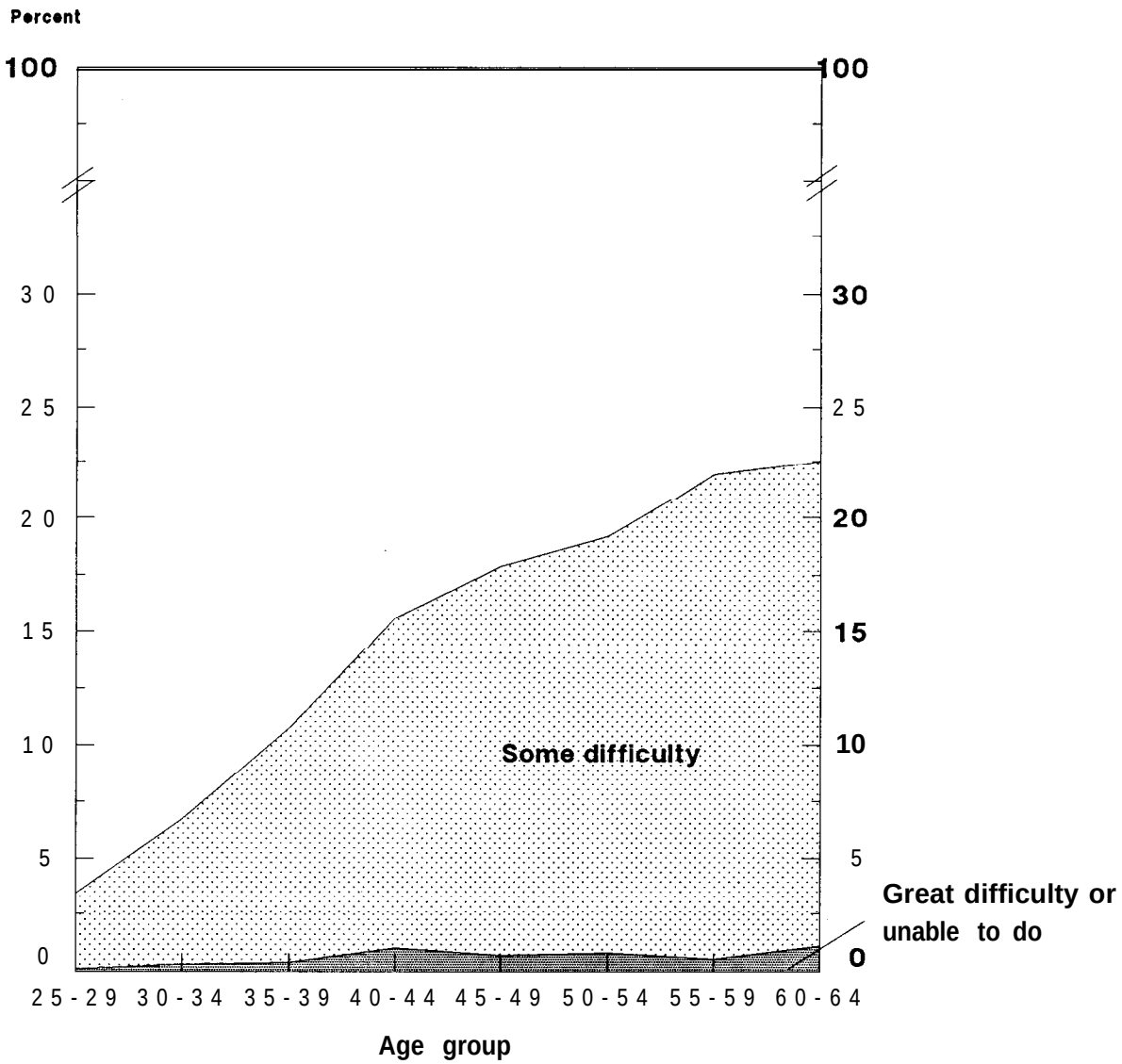
Figure 3.
Percent of Total Population with Work Disabilities, by Degree of Disability and Age



SOURCE: Bureau of the Census, Current Population Survey

See Table I-C.

Figure 4.
Percent of Scientists and Engineers by Degree of Functional Limitation and Age Group



SOURCE: National Science Foundation, National Survey of Natural and Social Scientists and Engineers

See Table IV-B.

Figure 5.

Effect of Functional Limitations on Selected Activities

SOURCE: National Science Foundation, National Survey of Natural and Social Scientists and Engineers

See Table IV-C.

3. TABLES

I. U.S. ADULT POPULATION

II. YOUTH

III. POSTSECONDARY EDUCATION

IV. SCIENCE AND ENGINEERING POPULATION

Table I-A. Limitation of Activity Due to Chronic Conditions, by Age

	Age groups:	18-24	25-44	45-64
	Total population (1,000):	28,006	70,115	44,322
National Health Interview Survey (1983-85)			(Percent)	
	Total with activity limitation	5.8	9.7	23.7
	Unable to perform major activity	1.6	2.3	8.4
	Limited in amount or kind of major activity	2.4	4.3	9.5
	Limited in non-major activity	1.8	3.1	5.8

Table I-B: Prevalence of Chronic Conditions

	Age groups:	18-44	45-64
	Total population (1,000):	103,066	45,573
National Health Interview Survey (1988)	Conditions	(Percent)	
	Visual impairment	2.9	4.8
	Hearing impairment	4.9	14.8
	Absence of extremities	0.5	0.9
	Paralysis of extremities	0.3	1.0
	Deformity or orthopedic impairment	13.1	15.1

Table I-C: Severe and Non-Severe Work Disabilities, by Age: 1981-88

	Ages:	16-24		25-34		35-44		45-54		55-64	
		Not Severe	Severe	Not Severe	Severe	Not Severe	Severe	Not Severe	Severe	Not Severe	Severe
Current Population Survey (1981-1988)	1981	1.8	1.4	2.9	2.3	3.8	3.4	5.8	6.5	9.2	14.4
	1982	2.0	1.4	2.8	2.3	3.8	3.3	5.6	6.6	9.5	
	1983		1.5	2.7	2.1	4.1	3.0	5.0	6.4	8.6	
	1984	1.9	1.2	2.8	2.4	3.8	3.1	5.2	6.3	9.0	14.5
	1985	2.2	1.4	2.6	2.2	3.8	3.5	5.4	6.2	10.0	13.7
	1986	2.1	1.6	2.8	2.5	3.8	3.4	5.3	5.9	8.9	14.4
	1987	1.8	1.7	2.8	2.6	3.9	3.6	5.0	5.9	8.6	13.6
	1988	2.1	1.7	2.9	2.7	3.4	3.6	4.3	6.0	8.3	14.0

fable I-D: Percent of Disabled in the Labor Force, by Gender: 1981-88

		In the labor force		Employed full time	
		Male	Female	Male	Female
		(Percent)			
Current Population Survey (1981-1988)	1981	41.9	23.5	29.8	11.4
	1982	41.5	23.7	27.4	11.9
	1983	41.0	24.4	26.2	11.2
	1984	40.3	24.4	27.1	11.4
	1985	38.2	25.3	25.5	12.0
	1986	38.0	25.2	25.8	11.3
	1987	39.7	27.1	26.3	12.7
	1988	35.7	27.5	23.4	13.1

Table I-E. Limitation of Work Activity Due to Chronic Conditions, by Education Level

	Education level:	8 years or less	9-11 years	12 years	13-15 years	16 or more years
National Health Interview Survey (1983-85)	Total population (1,000):	13,325	20,027	61,341	29,139	26,314
	"Limited in non-work activity"	(percent) 4.7	(percent) 3.5	(percent) 3.0	(percent) 3.2	(percent) 3.7
	"Unable to work"	22.4	10.9	5.1	3.3	1.9
	"Limited in amount or kind of work"	7.6	6.3	4.7	4.3	3.5

Table I-F: Functional limitation Status, by Work Disability Status: 1984

Survey of Income and Program Participatior (1984)	Functional Limitation Status	Total persons aged 16 to 64 (1,000)	With a work disability		With no work disability	
			Number (1,000)	Percent	Number (1,000)	Percent
	With a severe functional limitation	6,000	5,000	83%	1,000	17%
	With a non-severe functional limitation	15,700	6,800	43%	8,900	57%
	With no functional [imitation	129,300	6,000	5%	122,900	95%

Table I-6: Degree of Functional Limitation, by Aga Groups: 1984

Survey of Income and Program Participatior (1984)	Age Group	Total	With a functional Limitation					
			Total		Severe		Not Severe	
			Number	Percent	Number	Percent	Number	Percent
	Total persons (1,000)	154,565	21,839	14.1	5,997	3.9	15,842	10.2
	15-24	39,297	2,054	5.2	346	0.9	1,708	6.3
	25-X	40,464	3,049	7.5	596	1.5	2,453	6.1
	35-44	30,480	4,074	13.4	a90	2.9	3,184	10.4
	45-64	22,260	7,552	34.2	2,734	12.4	4,818	21.8

Table II-A. Limitation of Activity Due to Chronic Conditions Among Youth

	Age groups:	Under 5	5-17
	Total population (1,000):	17,975	44,675
National Health Interview Survey (1983-85)		(Percent)	(Percent)
	With Limitation in major activity"	1.6	4.4
	"Unable to carry on major activity"	0.5	0.4
	"Limited in amount or kind of major activity"	1.1	4.0

Table II-B: Prevalence of Chronic Conditions Among Youth

	Age groups:	Under 18
	Total population (1,000):	63,569
National Health Interview Survey (1988)	Conditions	(Percent)
	Visual impairment	0.9
	Hearing impairment	1.7
	Deformity or orthopedic impairment	2.9

Table II-C: Disability Status of Youth, by Age: 1984/85

Survey of Income and Program Participation 1984/85	Age Group	Total (1,000)	With a disability					
			Number	Percent	Physical only		Mental or emotional only	
					Number	Percent	Number	Percent
	Under 18	62,445	1,916	3.1	1,241	2.0	535	0.9
	0-2	10,953	136	1.2	118	1.1	8	0.1
	3-5	10,522	218	2.1	176	1.7	27	0.3
	6-9	12,893	443	3.4	287	2.2	122	0.9
	10-14	17,275	699	4.0		2.4		1.4
	15-17	10,802	420	3.9	288	2.2	288	1.3

Table II-D: 6-17 Year-Olds Served Under Education of the Handicapped Act, by Handicapping Condition: School Year 1987-88

	Handicapping Condition	Number (1,000)	Percentage of resident population	Percentage of estimated enrollment	Percent distribution
Education of the Handicapped Act 1987/88	ALL conditions	4,118	9.3	10.5	100.0
	Learning disabled	1,937	4.4	2.6	47.0
	Speech impaired	599	2.3	[illegible]	23.2
	Mentally retarded	374	1.2	1.4	14.5
	Emotionally disturbed	[illegible]	0.9	1.0	9.1
	Hard of hearing and deaf	57	0.1	0.1	1.4
	Orthopedically impaired	[illegible]	0.2	[illegible]	[illegible]
	Other health impaired	46	0.1	0.1	1.1
	Visually handicapped	23	0.1	0.1	0.6
	Deaf-blind	1	0.0	0.0	0.0

Table III-A: Postsecondary Students by Major Field of Study and Disability Status: Fall 1986

	Total postsecondary students	Field of study	Nondisabled students		Disabled students	
			Number	Percent	Number	Percent
National Center for Education Statistics (1989)	Undergraduate 11,213,432		10,005,139	89.2%	1,208,293	10.8%
		Arts & humanities	640,329	6.4%	89,414	7.4%
		Business				
		Education	2,811,442	28.1%	294,823	24.4%
		Engineering				
		Health	930,488	9.3%	118,415	9.8%
		General studies	690,355	6.9%	88,205	7.3%
		Natural sciences (1)	1,070,550	10.7%	129,287	10.7%
		Social sciences	730,375	7.3%	103,913	8.6%
		Trade/industrial	250,128	2.5%	38,665	3.2%
		All other	1,040,534	10.4%	137,745	11.4%
	Graduate 1,063,146		974,056	91.6%	89,090	8.4%
		Arts & humanities	93,509	9.6%	9,533	10.7%
		Business	208,448	21.4%	12,116	13.6%
		Education				
		Engineering	288,389	29.6%	42,000	47.1%
		Natural sciences	116,887	12.0%	9,087	10.2%
		Social sciences	92,535	9.5%	8,820	9.9%
		All other	182,148	18.7%	22,807	25.6%
	First professional 300,907		279,061	92.7%	21,846	7.3%
		Law	108,555	38.9%	10,901	49.9%
		Medicine	107,718	38.6%	5,549	25.4%
		Other medical	48,836	17.5%	4,347	19.9%
		Theology				
			13,674	4.9%	1,049	4.8%

(1) Includes life sciences, physical sciences, mathematics, and computer sciences.

Table III-E: Disabled Postsecondary Students, by Type of Disability: Fall 1986

	Prevalence of Disability	Type of Disability	Percentage of all students	Percentage of disabled students
National Center for Education Statistics (1989)	1,319,229	Total, any disability	10.5%	100.0%
	160,878	Learning disability	1.3%	12.2%
	514,681	Visual handicap	4.1%	39.0%
	265,484	Hard of hearing	2.1%	20.1%
	80,910	Deafness	0.6%	6.1%
	62,525	Speech disability	0.5%	4.7%
	231,491	Orthopedic handicap	1.8%	17.6%
	320,272	Health impairment	2.6%	24.3%

NOTE: Details do not add to total due to multiple disabilities.

Table III-C: Postsecondary Students by Disability Status and Selected Characteristics: Fall 1986

Selected Characteristic	Nondisabled students		Disabled students	
	Number	Percent	Number	Percent
Total students	11,260,514		1,319,229	
Sex				
Male	5,033,450	44.7%	670,168	50.8%
Female	6,227,064	55.3%	649,061	49.2%
Age				
15 to 23	6,283,367	55.8%	656,976	49.8%
24 to 29	2,229,582	19.8%	230,865	17.5%
30 or older	2,747,565	24.4%	431,388	32.7%
Dependency Status				
Dependent	6,700,006	59.5%	737,449	55.9%
Independent	4,560,508	60.5%	581,780	44.1%
Veteran Status				
Veteran	675,631	6.0%	150,392	11.4%
Not veteran	10,584,883	94.0%	1,168,837	88.6%

National Center for Education Statistics (1989)

IV. SCIENCE AND ENGINEERING POPULATION (NSF SURVEYS)

Table IV-A. Degree of Functional limitation

	Degree of Functional Limitation	Functional Limitation			
		Total	Seeing	Hearing	Walking
1989 NATIONAL SURVEY OF NATURAL AND SOCIAL SCIENTISTS AND ENGINEERS'	Total, with limitations	287,800	125,300	175,100	41,500
		(Percent of total scientists and engineers)			
	Total, with Limitations	16.4	7.1	10.0	2.4
	Great or unable to do	0.8	0.2	0.2	0.3
	Sane difficulty	15.7	6.9	9.8	2.0

These data are for the experienced population of scientists and engineers, *I.e.*, those persons who reported a science or engineering occupation on the 1980 Decennial Census.

NOTE: Detail may not add to totals because of rounding.

Table IV-g. Degree of Functional limitation, by Age

	Functional limitation	Total, all ages	Age 25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
	Total S&E	1,751,100	29,200	210,200	318,300	322,400	243,700	210,700	167,600	130,900
		(Percent of total scientists and engineers)								
1989 NATIONAL SURVEY OF NATURAL AND SOCIAL SCIENTISTS AND ENGINEERS*	TOTAL, WITH LIMITATIONS	16.4	3.4	6.7	10.7	15.6	18.0	19.2	21.9	22.5
	Great or unable to do	0.8	0.1	...	0.4			0.8		
	Some difficulty	15.7	3.3	0.3	10.3	14.8.8	17.8.7	18.4	21.48.5	2:::
	SEEING	7.1	1.8	2.3	4.8	9.0	10.1	8.8	7.4	6.8
	Great or unable to do	0.2	..	..	0.1	0.3	0.2	0.4	0.1	0.2
	Some difficulty	6.9	1.8	2.3	4.7	8.7	9.9	8.4	7.3	6.6
	HEARING	10.0	2.5	4.1	3::	7.7	9.1	12.4	14.7	15.6
	Great or unable to do	0.2	..	0.1		0.1	0.3	0.3	0.1	0.2
	Some difficulty	9.8	2.5	4.0	6.8	7.6	8.8	12.1	14.6	15.4
				1.0						
	WALKING	2.3	0.6	0.2	1.5	1.5	1.6	1.7	3.0	4.4
	Great or unable to do	0.3								0.8
	Some difficulty	2-0	0.5	0.8	0.4	0.8	0.8	0.5	0.6	3.6

*These data are for the experienced population of scientists and engineers, i.e., those persons who reported a science or engineering occupation on the 1980 Decennial Census.

NOTE: Detail may not add to totals because Of rounding.

Table IV-C. Functional Limitation by Effect on Activity

	Functional Limitation	COMPLETING EDUCATION			FINDING EMPLOYMENT			ADVANCING IN CAREER		
		No Problem	Some Problem	Severe Problem	No Problem	Some Problem	Severe Problem	No Problem	Some Problem	Severe Problem
		(Percent)								
1989 NATIONAL SURVEY OF NATURAL AND SOCIAL SCIENTISTS AND ENGINEERS*	otal, with limitations	85.2	3.0	0.5	84.7	2.4	1.1	81.1	6.3	1.2
	Seeing	85.3	3.2	0.3	84.0	2.6	1.7	80.8	6.4	1.4
	Hearing	86.3	3.1	0.3	87.2	1.4	0.9	82.7	5.9	0.9
	Walking	83.1	5.2	2.0	75.3	9.4	5.1	73.0	10.9	6.0

These data are for the experienced population of scientists and engineers, i.e., those persons who reported a science or engineering occupation on the 1980 Decennial Census.
NOTE: Row percents will not add to 100 because "no report" is omitted.

Table IV-D. Employment Status *by functional limitation*

	Functional limitation	Total Population	Total Employed	Unemployed, Seeking Employment	Outside the Labor Force
1989 NATIONAL SURVEY OF NATURAL AND SOCIAL SCIENTISTS AND ENGINEERS*	Total S&E	1,751,100	1,612,400	14,500	124,200
		(Percent of total scientists and engineers)			
	Total, with limitations	16.4	15.1	14.8	29.3
	Seeing	7.2	7.0	5.8	8.8
	Hearing	10.0	9.4	7.9	18.0
	Walking	2.4	1.8	4.4	9.4

*These data are for the experienced population of scientists and engineers, i.e., those persons who reported a science or engineering occupation on the 1980 Decennial Census.

NOTE: Detail may not add to totals because of rounding.

Table IV-E. Self-identified Physical Impairment by Type and Age

Source	Physical impairment	Total, all ages	Under 30	30-39	40-49	50-59	60 and over
1986 U.S. SCIENTISTS AND ENGINEERS*	Total, with impairments (1)	100,100	5,300	13,700	19,300	21,400	40,300
		(Percent of total scientists and engineers)					
	Total, with impairments	2.0	0.5	1.0	1.7	2.5	6.5
	Visual only	0.4	0.2	0.2	0.4	0.5	1.2
	Auditory only	0.3	0.1	0.3	0.3	0.4	0.7
	Ambulatory only	0.4	0.1	0.3	0.3	0.4	1.5
	Multiple impairments	0.2	..	..	..	0.3	0.9
1987 SURVEY OF DOCTORATE RECIPIENTS	Total, with impairments (1)	11,100	100	1,500	3,000	2,800	3,800
		(Percent of total scientists and engineers)					
	Total, with impairments	2.5	1.6	1.2	1.8	3.2	5.9
	Visual only	0.5	..	0.4	0.4	0.6	0.9
	Auditory only	0.4	..	0.2	0.3	0.6	0.8
	Ambulatory only	0.6	..	0.2	0.4	0.8	1.7
	Multiple impairments	0.2	..	..	0.1	0.3	0.8
1986 NATIONAL SURVEY OF NATURAL AND SOCIAL SCIENTISTS AND ENGINEERS-	Total, with impairments (1)	37,600					
		(Percent of total S&E)					
	Total, with impairments	2.1					
	Visual only	0.6					
	Auditory only	0.4					
	Ambulatory only	0.5					

(1) Includes respondents whose specific impairment was not reported.
*Data from this source were generated by combining survey results for experienced scientists and engineers as well as survey results for persons who entered the SLE work force after the 1980 Decennial Census.
**These data are for the experienced population of scientists and engineers, i.e., those persons who reported a science or engineering occupation on the 1980 Decennial Census.

Table IV-F. Self-identified Physical Impairments of S&E Graduates by Type and Degree Level

Source	Physical impairment	S&E graduates
SURVEY OF RECENT SCIENCE AND ENGINEERING GRADUATES (1986-87 GRADUATES IN 1988)	BACHELOR'S RECIPIENTS	628,000
		(Percent of total)
	Total, with impairments (1)	1.0
	Visual only	0.2
	Auditory only	0.2
	Ambulatory only	0.5
	Multiple impairments	-
	CUSTER'S RECIPIENTS	114,200
		(Percent of total)
	Total, with impairments (1)	0.4
	Visual only	0.1
	Auditory only	0.1
	Ambulatory only	0.1
	Multiple impairments	••
SURVEY OF EARNED DOCTORATES (1987 AND 1988 COMBINED)	NEW PH.D. RECIPIENTS	39,600
		(Percent of total)
	Total, with impairments (1)	1.0
	Visual only	0.3
	Auditory only	0.2
	Ambulatory only	0.3
	Vocal only	••

(1) Includes respondents whose specific impairment was not reported.